DOCUMENT RESUME

ED 175 900 TM 008 854

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TITLE Immediate and Delayed Recall of Incidentally Learned Material: A Comparison of Paradigms Across Three Developmental Levels.
PUB DATE [Apr 79]
NOTE 18p.; Paper presented at the Annual Meeting of the American Educational Research Association (63rd, San Francisco, California, April 8-12, 1979)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Age Differences; Cognitive Development; Elementary Education; Higher Education; *Incidental Learning; *Learning Characteristics; Learning Processes; *Memory; Pictorial Stimuli; *Recall (Psychological); Time Factors (Learning)

ABSTRACT

Memory of incidentally learned material was investigated across three developmental levels in immediate and 24-hour delay conditions. First grade, sixth grade, and college students were assigned randomly within developmental level to one of four experimental conditions: Type I immediate, Type I delay, Type II immediate, or Type II delay. In the Type I paradigm, subjects looked at pictures but were given no explicit instruction to remember, and in the Type II paradigm, subjects were instructed to remember specific pictures when shown all stimuli. A four way fixed-factor analysis of variance yielded significant main effects for developmental level, incidental paradigm, and recall condition. Paradigm interacted with recall condition, and significant amounts of incidental learning proved durable for sixth graders and college students. Incidental learning increased with age in both paradigms, suggesting that previously reported divergent developmental trends may not be the result of the type of paradigm. (Author/RD)

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Immediate and Delayed Recall of Incidentally Learned Material: A Comparison of Paradigms Across Three Developmental Levels

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The research presented was part of the master's degree requirements for the first author at Arizona State University. Special thanks are extended to M. Austin Betz and Maurine Fry for their support and advisement and to the teachers and children of Rover Elementary School in Tempe, Arizona.

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TM008 854

Running Head: Incidental Learning

Abstract

Memory of incidentally learned material was investigated across three developmental levels in immediate and delay conditions. Subjects (56 first graders, 56 sixth graders, and 56 college students) were assigned randomly within developmental level to one of four experimental conditions: Type I immediate, Type I delay, Type II immediate, or Type II delay. In the Type I paradigm, subjects looked at pictures but were given no explicit instruction to remember, and in the Type II paradigm, subjects were instructed to remember specific pictures when shown all stimuli. Paradigm interacted with recall condition and significant amounts of incidental learning proved durable for sixth graders and college students. Incidental learning increased with age in both paradigms suggesting that previously reported divergent developmental trends may not be the result of the type of paradigm.

Immediate and Delayed Recall of Incidentally Learned Material: A Comparison of Paradigms Across Three Developmental Levels

Much of what people remember is material they never intended to learn. This unintentional, incidental, learning has been studied within two paradigms differentiated by Postman (1964). In the first paradigm, Type I, subjects interact with stimulus materials but are given no instruction to learn or memorize the material. In the second paradigm, Type II, subjects are given a specific learning task while also being exposed to materials that are not described by the learning instructions. Immediately following either type of instruction subjects are asked to recognize or recall all stimuli.

Vaughan (1968) and Gottfried (Note 1) indicated Type I incidental learning increased with age. In these studies, subjects interacted with incidental materials by making up sentences, naming pictures, making discriminations, or circling items.

In Type II incidental learning, subjects served as both intentional and incidental learners, and were therefore exposed to relevant and irrelevant materials simultaneously. Five studies using the Type II paradigm have indicated that incidental learning remained constant or declined after 13 years of age (Dusek, 1978; Hagen, 1967; Hagen & Hale, 1973; Siegel & Corsini, 1969; Smirnov & Zinchenko, 1969). Deichmann, Speltz, and Kausler (1971), however, presented evidence that incidental learning continued to increase beyond age 13.

Gottfried (1976) attempted to clarify the relative effects of the Type I and Type II paradigms on learning. She found incidental learning increased with age in both paradigms for first and sixth graders. Although the focus of the present study was the effect of a delay on recall of incidentally learned material, inclusion of a college age sample extended the developmental description of incidental learning within two paradigms.

Durability of memory for incidentally learned materials has been virtually overlooked. Although most research has concerned immediate memory of incidental material, Hetherington and Banta (1962) and Tresselt and Mayzner (1960) used the Type I paradigm and found that incidental learning decreased significantly after a 48-hour delay. Evidence was not available regarding the effect of delay on Type II incidental learning. Based on knowledge of strategic memory development (Flavell, 1977), it was expected that after a significant delay subjects instructed to learn a portion of material would be more able to access memory for accompanying incidental material than those given no explicit instruction to learn.

At present, generalizing results of incidental learning studies to long-term memory is unwarranted. It may be, as Brown (1975) and Smirnov and Zinchenko (1969) have hypothesized, that incidental memory is not transient or insignificant and has important educational implications. Realistic delay periods are necessary to test this hypothesis.

The study reported here follows Gottfried's (1976; Note 1) use of the free recall task. In her study, Gottfried (1976) included a matching task and a free recall task and found incidental learning increased with age in both tasks. Although the present study does not replicate Hagen's task, the free recall task provides a fair test of the relationship of age and

Type II incidental learning. The stimulus materials of this study were developed and used by Gottfried (1976) and are identical in number and arrangement to those used by Hagen and Hale (1973). Hagen and Hale, however, used two categories of stimuli (i.e., animals and household objects), whereas Gottfried's stimuli were not easily categorized.

We examined the durability of incidental learning as measured by a free recall task in two paradigms across three ages. It was hypothesized that (a) significant amounts of incidentally learned material would be recalled after a 24-hour delay and (b) the percentage of incidentally learned material recalled would be significantly greater for each older age group in both Type I and Type II paradigms. The effects of delay across ages and paradigms were examined.

Method

Design and Subjects

A four-way factorial design was used. The four factors were: (a) type of incidental learning paradigm (Type I and Type II), (b) recall condition (immediate and 24-hour delay), (c) developmental level (first grade, sixth grade, and college undergraduate), and (d) sex.

Subjects were 168 white, middle-class males and females. The first- and sixth-grade subjects were from a suburban elementary school in Tempe, Arizona, and had mean ages of 6.42 and 11.42 years, respectively. The college subjects were undergraduate education majors at a large university. Within each developmental level, 56 subjects, 28 males and 28 females, were assigned randomly to one of four experimental conditions (Type I immediate, Type I delay, Type II immediate, or Type II delay).

Materials

Eight pairs of pictures developed by Gottfried (Note 2) were presented in each condition. Each figure was a felt pen drawing of a common object. The pairs of pictures were neither conceptually nor perceptually related for elementary school children (Olver & Hornsby, 1966). The pairs were: flower-boat, tent-sun, shoes-hand, car-egg, lamp-tree, fruit-shirt, bee-house, and face-kite. Pair members were not the same colors. After minor alterations in two stimuli, 100% recognition was achieved by pilot subjects in first grade (15) and college (6). Each pair of pictures was centered on a separate sheet of white, 8½ x 11 inch (.21 m x .27 m) paper with the object named first in each pair placed 1 inch (.025 m) directly above the other.

Pretesting showed college students could not recall all the stimuli, thus avoiding a ceiling effect. In addition, it was found that probing or encouraging a subject to "think hard" resulted in increased recall.

Procedure

Each subject was seen individually by a male experimenter. After establishing rapport, the experimenter explained he wanted to show them a book with two pictures on each page.

Subjects in the Type I paradigm were instructed to look at each pair, one at a time, but were not informed of a later test of retention. The experimenter said, "I have a book of pictures I would like you to look at. Please sit quietly and turn the page when I tell you. O.K.?"

Subjects in the Type II paradigm were instructed, "I have a book of pictures I would like you to look at. Be sure to remember the top picture on each page. Please sit quietly and turn the page when I tell you. O.K.?" Before showing the stimulus materials to subjects in the Type II paradigm,

each one was presented with a line drawing of two boxes, one directly above the other. All subjects could differentiate top from bottom and indicated they understood the instructions.

Following the appropriate instruction, the subject was handed the notebook and told to open it to the first pair of pictures. The experimenter began timing when the pictures were fully exposed; 10 seconds later, he instructed the subject to turn to the next page. This procedure was continued for all eight pairs of pictures.

Free recall for subjects in the immediate recall condition within both paradigms began after the exposure of the final pair of pictures and the removal of the notebook. Subjects in the delayed recall condition were asked to return the following day to continue the task. All subjects were asked to name as many of the pictures as they could in any order and without a time constraint. All responses, correct or incorrect, were recorded verbatim.

Measures and Analysis

Measures derived for the recall tasks included the number of top pictures recalled, the number of bottom pictures recalled, and the number of pictures recalled after probing. In order for a label to be considered correct, three raters had to agree on the picture it identified. Raters were shown all 16 stimulus pictures and given a list of 42 alternative responses and asked to indicate which responses accurately described a picture. The inter-rater reliability was .88 (Miller, 1975, p. 25).

The comparable incidental learning measure for the Type I and Type II paradigms was a percentage representing the number of incidental stimuli recalled out of the total possible incidental stimuli. In the Type I

paradigm, all 16 stimuli were incidental and in the Type II paradigm, the eight bottom stimuli were incidental.

The dependent variable, percentage of incidental material recalled, was analyzed with a 3 (Developmental Level) x 2 (Incidental Learning Paradigm) x 2 (Recall Condition) x 2 (Sex) fixed-factor analysis of variance.

Results

A four-way fixed-factor analysis of variance on incidental recall scores yielded significant main effects for developmental level (First Grade $\bar{X}$ = 21%, Sixth Grade $\bar{X}$ = 33%, College $\bar{X}$ = 48%), $F(2, 144) = 72.38$, $p < .001$; incidental paradigm (Type I $\bar{X}$ = 46%, Type II $\bar{X}$ = 22%), $F(1, 144 = 590.64$, $p < .001$; and recall condition (Immediate $\bar{X}$ = 39%, Delayed $\bar{X}$ = 28%), $F(1, 144) = 39.61$, $p < .001$. There were no significant main effect or interactions involving sex.

The interaction between incidental paradigm and recall condition was significant, $F(1, 144) = 9.74$, $p < .002$. This indicated that the number of incidental stimuli recalled within a particular paradigm varied according to the recall condition. Subjects' incidental recall was greater in the Type I than the Type II paradigm for both immediate and delay conditions, and the percentage of stimuli recalled within a paradigm decreased differentially over time. Simple main effects analyses (Kirk, 1968, p. 179) revealed that the percentage of Type I immediate recall ($\bar{X}$ = 53%) was significantly greater ($p < .01$) than delayed recall ($\bar{X}$ = 39%). In the Type II paradigm, the percentage of incidental stimuli recalled in the immediate condition ($\bar{X}$ = 25%) did not differ significantly from that in the delay condition ($\bar{X}$ = 17%).

The interaction between developmental level and incidental paradigm was also significant, $F(1, 144) = 15.91$, $p < .001$. The graph of this

interaction in Figure 1 indicates clearly that (a) the differences between percentage recalled at each developmental level did not vary uniformly across paradigm, (b) in both the Type I and Type II paradigms older subjects recalled more incidental stimuli than younger subjects, and (c) all age groups recalled more incidental stimuli in the Type I than the Type II paradigm. Within the Type I paradigm, tests of simple main effects indicated that the percentage of incidental stimuli recalled was significantly different ($p < .01$) between first graders and sixth graders, and between sixth graders and college students. In the Type II paradigm, only the difference between sixth graders and college students was significant.

Insert Figure 1 about here

Instructions were effective. Subjects recalled a greater percentage of top stimuli in the Type II than the Type I paradigm (Type I $\bar{X}$ = 48% vs. Type II $\bar{X}$ = 63%). The percentage of top stimuli recalled by sixth graders (Type I $\bar{X}$ = 53% vs. Type II $\bar{X}$ = 76%) and college students (Type I $\bar{X}$ = 63% vs. Type II $\bar{X}$ = 79%) in the Type II paradigm was significantly greater ($p < .01$) than in the Type I paradigm. The percentage of top stimuli recalled by first graders in the two paradigms was not significantly different (Type I $\bar{X}$ = 29% vs. Type II $\bar{X}$ = 35%).

The materials developed by Gottfried (1976) and the free recall task proved adequate for a wide age range of subjects. No subject at any developmental level recalled all incidental items on either the Type I task (where 16 items were defined as incidental) or the Type II task (where 8 items were defined as incidental). The absence of a ceiling

effect is evidenced in the means and standard deviations for the number of incidental stimuli recalled in each condition (Table 1).

Insert Table 1 about here

Discussion

In the present study, we examined effects of time of recall and incidental paradigm on the memory performance of first-grade, sixth-grade, and college students. We found (a) a differential decrease of incidental learning across paradigms for immediate and delayed recall and (b) an increase in immediate recall of incidentally learned material with age in both paradigms.

The difference between immediate and delayed recall was significant for subjects in the Type I, but not the Type II paradigm. This indicated memory for incidentally learned material decreased faster or was processed less in the Type I than the Type II paradigm. After a 24-hour delay in recall, sixth grade and college students recalled substantial amounts of incidental material indicating that incidental learning is not transient. In addition, the interaction of paradigms and time of recall suggests that immediate recall alone cannot adequately describe incidental learning.

In the immediate recall condition, memory for incidentally learned material increased with age in both the Type I and the Type II paradigms. Although previous researchers (with different materials and tasks) have found memory performance in the Type II paradigm to level off or decline at about 12 or 13 years of age, the present study of memory for incidental

stimuli indicated the extended developmental trend within both paradigms is toward increased competence.

The immediate recall condition Type I instruction resulted in higher percentages of incidental learning at all three developmental levels. The immediacy of the task appeared to reduce the amount of possible interference and allowed subjects to use an elementary strategy to retrieve the incidental material. Several subjects reported "running a movie over in their mind," indicating a sequential or "instant-replay" approach to the task. In the Type II immediate recall condition subjects were instructed to remember the top stimuli. These subjects apparently focused attention on the intentional stimuli; or the instruction to remember induced a specialized storage strategy which hindered immediate incidental recall.

The results of the present study raise several questions. What is the developmental pattern of incidental learning in preadolescence and adolescence when a range of materials, tasks, and lengths of task are examined? What is the effect of longer delays, one to two weeks, on incidental learning in both paradigms? To what extent does memory capacity interact with paradigms, tasks, and delay conditions? Examination of these questions may increase knowledge of paradigmatic effects in incidental learning and extend the utility of incidental paradigms in cognitive research.

Reference Notes

1. Gottfried, A. E. Effects of children's production of cognitive mediators on incidental learning. Paper presented at the 86th Annual Convention of the American Psychological Association, San Francisco, August 1977.

2. Gottfried, A. E. Personal communication, September 20, 1977.

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Table 1

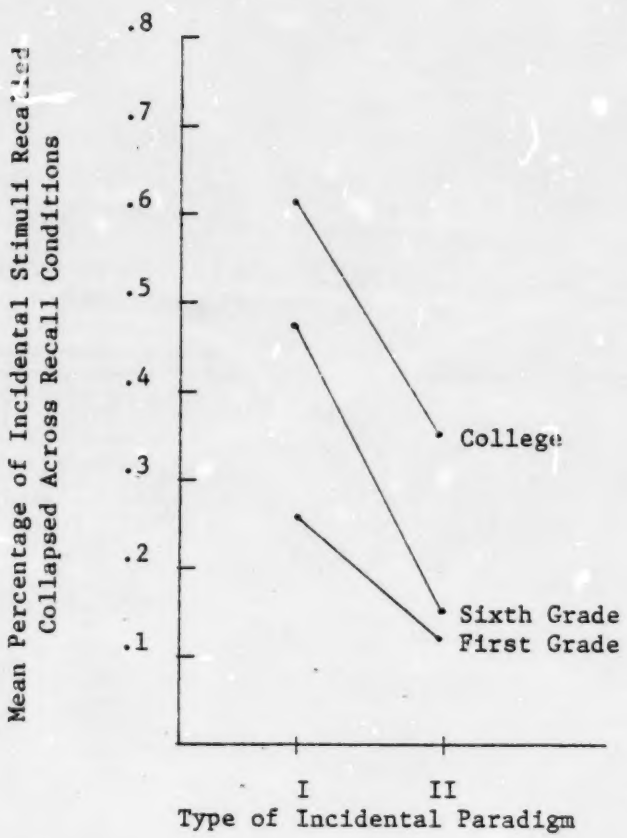
Mean Number of Incidental Stimuli Recalled

		Developmental Level		
		First Grade	Sixth Grade	College
TYPE I				
Immediate	$\bar{X}$	6.14	8.50	10.79
	SD	1.68	1.76	2.08
Delay	$\bar{X}$	3.36	6.93	8.57
	SD	0.89	1.53	1.12
TYPE II				
Immediate	$\bar{X}$	1.29	1.64	3.36
	SD	1.39	1.80	1.54
Delay	$\bar{X}$	0.57	1.14	2.36
	SD	0.49	0.74	1.49

Note. The Type I subjects received 16 possible incidental stimuli and Type II subjects received 8.

Figure Caption

Figure 1. Developmental level x paradigm interaction for mean percentage of incidental stimuli recalled.


Mean Percentage of Incidental Stimuli Recalled
Collapsed Across Recall Conditions
.8
.7
.6
.5
.4
.3
.2
.1
College
Sixth Grade
First Grade
I
II
Type of Incidental Paradigm